

study of the physical world. By demonstrating the powers of the human mind, the Scientific Revolution gave thinkers great confidence in reason and led eventually to a rejection of traditional beliefs in magic, astrology, and witches. In the eighteenth century, this growing skepticism led thinkers to question miracles and other Christian beliefs that seemed contrary to reason.

## I The Copernican Revolution

In proclaiming that the earth was not stationary but revolved around the sun, Nicolaus Copernicus (1473–1543) revolutionized the science of astronomy. Fearing controversy and scorn, Copernicus long refused to publish his great work, *On the Revolutions of the Heavenly Spheres*. However, persuaded by friends, he finally relented and permitted publication; a copy of his book reached him on his deathbed. As Copernicus anticipated, his ideas aroused the ire of many thinkers.

Both Catholic and Protestant philosophers and theologians, including Martin Luther, attacked Copernicus for contradicting the Bible and Aristotle and Ptolemy, and they raised several specific objections. First, certain passages in the Bible imply a stationary earth and a sun that moves (for example, Psalm 93 says, "Yea, the world is established; it shall never be moved"; and in attacking Copernicus, Luther pointed out that "sacred Scripture tells us that Joshua commanded the sun to stand still, and not the earth"). Second, a body as heavy as the earth cannot move through space at such speed as Copernicus suggested. Third, if the earth spins on its axis, why does a stone dropped from a height land directly below instead of at a point behind where it was dropped? Fourth, if the earth moved, objects would fly off it. And finally, the moon cannot orbit both the earth and the sun at the same time.

### Nicolaus Copernicus ON THE REVOLUTIONS OF THE HEAVENLY SPHERES

*On the Revolutions of the Heavenly Spheres* was dedicated to Pope Paul III, whom Copernicus asked to protect him from vilification. In the dedication, Copernicus explains his reason for delaying publication of *Revolutions*.

To His Holiness, Pope Paul III, Nicholas  
Copernicus' Preface to His Books  
on the *Revolutions*

I can readily imagine, Holy Father, that as soon  
as some people hear that in this volume, which  
I have written about the revolutions of the

## 2 Expanding the New Astronomy

The brilliant Italian scientist Galileo Galilei (1564–1642) rejected the medieval division of the universe into higher and lower realms and proclaimed the modern idea of nature's uniformity. Learning that a telescope had been invented in Holland, Galileo built one for himself and used it to investigate the heavens.

Through his telescope, Galileo saw craters and mountains on the moon; he concluded that celestial bodies were not pure, perfect, and immutable, as had been believed. There was no difference in quality between heavenly and earthly bodies; nature was the same throughout.

### Galileo Galilei

#### THE STARRY MESSENGER

In the following reading from *The Starry Messenger* (1610), Galileo reported the findings observed through his telescope, which led him to proclaim the uniformity of nature, a key principle of modern science.

About ten months ago a report reached my ears that a certain Fleming [a native of Flanders]\* had constructed a spyglass by means of which visible objects, though very distant from the eye of the observer, were distinctly seen as if nearby. Of this truly remarkable effect several experiences were related, to which some persons gave credence while others denied them. A few days later the report was confirmed to me in a letter from a noble Frenchman at Paris, Jacques Badovere,† which caused me to apply

\*Credit for the original invention is generally assigned to Hans Lippershey, a lens grinder in Holland who chanced upon this property of combined lenses and applied for a patent on it in 1608.  
†Badovere studied in Italy toward the close of the sixteenth century and is said to have been a pupil of Galileo's in about 1598. When he wrote concerning the new instrument in 1609, he was in the French diplomatic service at Paris, where he died in 1620.

myself wholeheartedly to inquire into the means by which I might arrive at the invention of a similar instrument. This I did shortly afterwards, my basis being the theory of refraction. First I prepared a tube of lead, at the ends of which I fitted two glass lenses, both plane on one side while on the other side one was spherically convex and the other concave. Then placing my eye near the concave lens I perceived objects satisfactorily large and near, for they appeared three times closer and nine times larger than when seen with the naked eye alone. Next I constructed another one, more accurate, which represented objects as enlarged more than sixty times. Finally, sparing neither labor nor expense, I succeeded in constructing for myself so excellent an instrument that objects seen by means of it appeared nearly one thousand times larger and over thirty times closer than when regarded with our natural vision.